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Methods of Nature Study

A Pamphlet for the use of Students in Methods of Nature Study and Elementary Science

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INTRODUCTION

The practical problem, which now confronts the advocates of nature-study, is to formulate some general principles which may guide teachers in organizing nature-study work. The formation of the American Nature-Study Society is a step in the right direction. Professor Bailey, its president, advocates that the society, or a committee from the society, put in concrete form results of the ideas that have been repeatedly expressed. This would at least afford a central point for discussion from which might eventually come a generally accepted basis for a course of study.

Gradually the difficulties which have stood in the way of a general introduction of nature-study into the schools are being removed. The teachers are getting in sympathy with the observational methods and are recognizing the general aims of nature-study. Superintendents and principals are becoming convinced of the educational and ethical value of nature-study. Parents are finally losing the idea that nature-study is a fad. In order that there may not be reaction it is quite necessary that our work be organized. The lines of organization may be broad, it seems that they should be broad, but they must be definite if nature-study is to have a permanent place in our school curriculum.

Biologists have been most active in establishing nature-study in the schools and in working out courses, lessons, and suggestions. Biological facts are the basis of most of the text-books of nature-study. As a consequence, in the average teacher's mind, nature-study material means plants and animals. We are all agreed that material for nature-study comes

from the fields of meteorology, geology, mineralogy, physical geography, physics and chemistry, as well as from the field of biology. Why, then, in our courses, lessons, plans, and suggestions permit the biological to dominate? We say that nature-study is an attitude of mind. Why not get into this attitude and incorporate in our writings all kinds of nature-study facts rather than biological facts only? If teachers in the public schools are to be in sympathy with the movement, the leaders must be natural scientists instead of biologists, physicists, chemists, or geologists. The writer wishes to state here that he has been trained along the lines of biological rather than other science.

In the discussion of aims, methods, and materials there has been expressed great difference of opinion. Note for instance the points made in the discussions of Dr. Hornaday's article on the weakness of nature-study. (Nature Study Review, Jan. 1907). Some of the writers had in mind, as did Dr. Hornaday, only the upper grades, while others were evidently thinking of the lower grades. Very little emphasis has been placed upon the distinctions that should be made between the first and last years of the work in the elementary school. Almost without exception writers apply to the grades as a whole, ideas which relate to a limited portion only. A separation of the discussion might harmonize some apparently diverse views. The fifth or sixth year seems to mark some break in school work. Primary (1-5) grades are on a different basis than the grammar (6-8) grades. This division of the elementary school, primary, grades 1-5, grammar, grades 6-8, appears to be a logical educational distinction and applies not only to subject-matter but also to presentation.

The chief aim in the primary grades should be to acquaint the child with many of the forms of nature. The work is essentially perceptive, perception of things and the visible relationships of things. The material is therefore mainly minerals, plants, and animals. The actual presence of the objects in the hands of a common-sense teacher is the main factor for success. The aquarium, the vivarium, potted plants, the school garden, and the daily phenomena of meterology, sup-

plement excursions which should of course always have first consideration. Expression should be for the most part oral and as informal and conversational as possible. Vividness of presentation should be the means of fixing the knowledge. This part of the work has been well thought out and nature-study in its present form and significance is well suited to the primary grades.

The work of the grammar grades ought to be along two separate lines—one for boys and one for girls—but as this is not practicable and there seems to be little tendency toward a condition which will make it practicable, I am inclined to favor the boys. The work should be presented in the problem form. The students should be encouraged to suggest as many of the problems as possible and then be allowed to determine the means of working them out. The student should be led to explain for himself certain phenomena, with which he comes in daily contact, in order that he may come into an understanding relationship with his environment and at the same time increase his ability to solve for himself practical problems (not mathematical). With this end in view, the following points should be made important:

(1) The pupil and not the subject-matter is the first consideration.

(2) The subject-matter is to be a means and not an end.

(3) The problems are to be solved in the light of the horizon of the pupil and not that of the research student.

Physical and chemical phenomena seem to be the best material for this work. The experiments run through a short period of time and the conditions are easily controlled. Results are definite and many secondary problems suggest themselves. In none of the work should there be any attempt to develop mathematical formulae or formal definitions. In considering the pendulum, my students of the seventh year worked out the following laws:

(1) The weight of the pendulum bob makes no difference in the number of swings of the pendulum in a given time.

(2) The length of the swing of the pendulum bob makes no

difference in the number of swings of the pendulum in a given time.

(3) The shorter the pendulum rod, the greater the number of swings of the pendulum in a given time.

At the request of the teacher, the students themselves decided what might affect the number of swings, devised the experiments, and finally agreed upon the above as the laws which govern the swinging of the pendulum.

In the eighth year the present elementary biology planned for the first year of the high school, with some expansion of the introductory experiments in chemistry and an elimination of some of the structural work, makes an excellent course.

Summary

1. Times are propitious for a general introduction of science study in the schools.
2. Biological material should not be dominant.
3. Nature-study in the primary grades.
4. Elementary science in the grammar grades.

The above is an extract from a paper read at a joint meeting of the Nature-Study Section of the New York State Teachers' Association and the State Science Teachers' Association held at Syracuse December, 1908.

The Note Book

The note book should contain a record of the important facts obtained by consulting authorities, performing experiments, and making observations.

Clearness and permanence of mental impressions depend upon the vividness, exactness, and thoroughness of experience with the object or idea and upon relationship established with mental impressions already familiar. To this end the hints concerning the making of a note book are directed.

A good note book should be neat, exact and concise. In making the book concise, however, no important facts should be omitted.

The drawings are to be suggestive. A mere outline is sufficient, but this should be definite. The drawing is not an end but a means. It expresses what could only with difficulty be expressed in words.

The note book as a mere compendium of second-hand facts means little and as such is not worth the time of making. Be as original and independent in your work as possible. One student's note book should be as different from his neighbor's as he is different from his neighbor.

The student's attitude toward the subject should be that of the original discoverer. The work is not assigned for the sole purpose of putting the facts in his possession. He is expected to grow in the work and become a reliable, progressive investigator. Mere acquisition or corroboration of facts is time wasted unless he is finding out things for himself. He is to become proficient in problem solving. To do this he must solve problems.

Aim at unity of ideas in written work. All writing should be in ink. It should be of good composition, carefully paragraphed and plainly written. Spell correctly.

Ask questions freely. A good question from a student is ofttimes better evidence of the progress of that student than a good answer to a good question from the teacher.

Aims of Nature-Study

The history of science teaching shows us that there have been several marked stages in its evolution to the present form. The development of nature-study has been along similar lines.

Old natural histories were mainly devoted to illustrations and descriptions of monsters and monstrosities of foreign countries. The unusual and startling features of nature were the basis of study.

Discuss this idea of nature-study in the light of present theory:

1. The means of study necessitated.
2. The effect of such an aim on the child.

Early in the history of science teaching, and especially so in the teaching of nature study, the aim of utility was introduced,—a practical doctrine measured in dollars and cents and that to the exclusion of other important considerations.

Discuss this aim of nature-study:

1. Its advantages in contribution.
2. Its disadvantages in limitation.
3. Its present meaning.

The next dominant aim in nature study was training in mental discipline. This in a broad sense was an excellent aim, but reduced to school room practice became lifeless. The test of efficiency became the power to describe.

Discuss the dicipline aim of nature study.

1. What is the chief tendency of a disciplinary aim?
2. Is this a live aim?
3. How avoid the dangers of such an aim?
4. How is such an aim related to language training?

As more attention has been paid to elementary education in recent years, the development of that stage of education has become more marked. Nothing could be more natural, however, than that these schools should be formulated on the lines of those already established, i. e., colleges and universities. So with the recent development of nature-study in the elementary school, it has taken its form from the higher

schools. As a result, the aim of nature-study up to the last few years inclined to scientific classification. In fact the first general introduction of nature-study into our public schools was along these lines. Even to-day there are many, if not a majority, of scientists and science teachers who maintain that the aim of nature-study should be scientific.

Discussion:

1. Formulate an argument in favor of the above aim.
2. Formulate an argument against the above aim.

The present conception of nature-study has as its pedagogical foundations a double aim. (1) To foster and cultivate the inborn interest which every child has in nature. (2) To develop in a normal and natural way the powers of observation, memory, and reason.

Discussion formulated on the following statements:

1. Interest is intensified by knowledge.
2. Interest is extended by knowledge.
3. Memory is, to some extent at least, dependent upon interest and extent of knowledge.
4. The formulation of correct premises in reasoning is dependent upon the extent, accuracy, and range of knowledge and observation.

References

Special Method in Elementary Science—Charles A. McMurry.

Nature Study Review, Vol. 3, No. 1, p. 1.—Maurice A. Bigelow.

Nature Study Review, Vol. 3, No. 4, p. 102—Mary P. Anderson.

Nature Study Review, Vol. 3, No. 6, p. 162—Elliot R. Downing.

Nature Study—Frederick L. Holtz.

The Study of Nature—Samuel C. Schmucker.

Nature Study and Life—Clifton F. Hodge.

Nature-Study and Science

Assuming that by consensus of opinion the following are the characteristics of nature study: (1) observation, the fundamental method; (2) common things in nature, the important materials; (3) human interests in every day life, the point of view, contrast nature-study and science, (1) as to materials for study, (2) as to method of study, (3) as to the point of view.

Every child learns to read. Is the ability to read in itself the aim of reading teaching? Is it desirable that the child should be interested in reading for its own sake or only from the utility stand-point? Would the child have much interest in the ultimate aim of reading teaching? Does the teacher have in mind the idea that reading or the ability to read is a means, not an end? Apply these questions to the discussion in hand concerning nature-study and science.

All mathematics is based upon a few fundamental operations. Is there any mention made of the later functions of these operations when they are presented in the ordinary course of the education of the child? Does the teacher know of the importance of these operations? Ought there to be any evidence of such knowledge in the teaching of arithmetic? Apply the above questions to the problem in hand.

References

Principles of Secondary Education, Vol. 2, p. 131—De Garmo.

Nature-Study Review, Vol. 4, No. 2, p. 33—Maurice A. Bigelow.

Nature-Study Review, Vol. 4, No. 2, pp. 41-51—Various Authors.

Nature-Study Review, Vol. 4, No. 1, p. 10—Stanley Coulter.

Nature-Study Review, Vol. 4, No. 1, p. 16—Clifton R. Hodge.

Nature-Study Review, Vol. 4, No. 1, p. 20—C. R. Mann.

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Nature study

Media of Instruction (General)

I. Intellectual transmission.

A. Language.

(1) Oral discourse.

(a) Lectures.

(b) Questions and answers.

(2) Books.

(a) Text-book.

(b) Reference books.

(c) Source books.

B. Visual impression.

(1) Observation.

(a) Direct.

(b) Experimental.

(2) Graphic representation.

(a) Models.

(b) Pictures.

(c) Maps.

(d) Diagrams.

II. Emotional transmission.

(a) Literature.

(b) Pictorial art.

(c) Plastic art.

(d) Music.

(e) Oratory.

Discuss the place of nature-study in this scheme.

Materials

What *particular* materials to use in nature-study will always be an open question. The great diversity in conditions makes the problem a different one for each teacher. Equipment, time, weather, class of children, and locality, all variables, enter into its solution. Concerning the *general* character of the material there is an almost unanimous opinion. Nearly all agree that animals, plants, or rocks serve equally well for material, the one determining factor being their accessibility. Study those things which are near at hand and are closely related to the lives of the children.

Discuss the last statement:

1. From the standpoint of Psychology.
2. From the standpoint of Science.
3. From the standpoint of Economy.

In general, it is best to separate the topics treated according to the capacity of the child, even though the same topic recur in several grades. The lower primary grades (1st and 2d) deal with concrete types with special emphasis on appearance and most noticeable activities. The aim is to acquaint the child with as many as possible of the objects of nature in his immediate surroundings. Perception is the chief mental activity to be cultivated. The range is broad and the work extensive rather than intensive. In the upper primary grades (4th and 5th) comparison and relationships are emphasized. The aim is to establish in the child's mind the associations and interdependence of the objects of nature. Attention is also paid to the economic importance of the objects. The familiar objects taught in the lower grades furnish many of the concepts for this work. Judgment is the mental activity to be mainly considered. The work of the third grade combines the two aims mentioned above and is the transition stage. The material in these primary grades is mainly biological, geological, and meteorological. In the grammar grades the material is mainly physical and chemical. In these upper grades the aim is to acquaint the child with the common physical and chemical phenomena of nature. Reason is the

chief mental activity to be cultivated. Demonstration is the means of furnishing the observational matter and the mental construction is carried on by careful questioning. The work is thrown into problem form and the problem stated in the form of a question.

Discuss this arrangement of material:

1. Regarding the development of the individual.
2. In respect to the natural interests of the child.
3. As fitted to the methods of study advocated.

There are, in general, two ways of bringing facts to the attention of pupils. The teacher may narrate and describe or he may set a problem which is to be solved by the pupils. The latter method is well illustrated in a question asked by the teacher and answered by the pupil. The question is the problem and the answer is the result of work on the part of the child. Thus we see that a series of questions is really a set of problems and as such afford an opportunity for thought on the part of the pupil. The question then resolves itself into a problem.

Since the child is not, in the beginning, apt at solving problems, they should be simple. As mental power grows, the problems should increase in complexity. To solve a complex problem one must resolve it into its simpler forms. These secondary problems must then be solved, after which the original problem will come up for consideration. This is the process gone through by anyone in the solution of a complex problem even though he is not conscious of the stages. Thus it seems best at first for the teacher to state the complex problem, and then resolve it into its simple secondary problems for the children in order to inculcate the habit of analyzing a problem into its simple forms. This explains why the good teacher has his questions cumulative, both for the day's lesson and for the whole time of instruction. This arrangement follows the natural thought processes and the natural development of the mental powers.

The choice of problems shows the degree to which the teacher has determined the capacity of his pupils. Here the teacher has an opportunity to develop the individual. The

slower and less efficient child should be given many simple problems and thus afforded an opportunity to develop his power of reasoning. The quick and apt pupil should be given more intricate problems. Every time the pupil answers a good question, no matter how simple or conrcete, he performs a genuine exercise in thinking. An answer which has been memorized tends to prevent thinking, e. g., the pupils get into the habit of learning a term and applying it as an answer to a certain question much as a reflex action. This is why we say that the same question when asked several times should be worded differently each time. The "yes" and "no" questions frequently fail to arouse thought. The problem should be stated to the whole class and then some one chosen to give the results. A complex problem may be very complex to some and comparatively simple to others. Questions for 1st and 2d grades are mainly to direct observation. The answers are the result of sense perception.

Questions for the 4th and 5th grades are mainly to develop relationship, function, cause and effect.

Questions of the upper grades run to complex form and aim to develop reasoning in its more complex forms.

Discuss the following points in relation to questioning:

1. Purposes of questioning.
2. Conditions essential for efficient questioning.
3. Essentials of a good question.
4. The results of successful questioning.

Special Topics

The following list of topics appears on the progress charts of the primary department. A lesson or series of lessons has been given on each of them during the past two years:

Air
Anemone
Ant
Apple
Aquarium
Aster
Bat
Bean
Bee
Beet
Beetle
Blackberry
Black bird
Blood root
Bluebird
Bobolink
Buckwheat
Buds
Bulbs
Burdock
Buttercup
Butterfly
Camel
Canary
Carrot
Cat
Caterpillar
Cedar Bird
Chalk
Cherry
Chestnut
Chickadee
Chipmunk
Clam
Clay
Clouds
Calendar
Clover
Coal
Cocoanut
Cocoons
Coffee
Coral
Corn
Cotton
Cow
Coyote
Crab
Cranberry
Crayfish
Cricket
Crow
Daisy
Dandelion
Dew
Dog
Donkey
Dragon fly
Duck
Eagle
Egg
Elephant
Elm
Evergreen
Feathers
Fern
Fish
Flowers
Fly
Forestry
Fox
Frost
Fruit
Galls
Gardens
Germination
Glass
Gold
Goldenrod
Goldfinch
Goose
Grape
Grasshopper
Grasses
Greyhound
Hairworm
Hare
Hedgehog
Hen
Hepatica
Holly
Horse
Horsechestnut
Humming Bird
Ice
Insects, beneficial
Insects, harmful
Iris
Iron
Jack-in-Pulpit
Leaves
Lemon
Lilac
Lily
Linen
Lobster
Lumber
Maple
Maple Sugar
Milkweed
Mole
Moon
Mosquito
Moss
Moth
Mould
Mouse
Muskrat
Mushrooms
Nasturtium
Nests
Nuts
Oak apples
Oak Tree
Onion
Orange
Oriole
Ostrich
Owl
Oyster
Paper
Parrot
Pea
Peanut
Pear
Peat
Phoebe Bird
Pig
Pigeons
Pines
Plants
Plum
Poisonous plants
Porcupine
Potato
Propagat'n,plant
Pumpkin
Pussy Willow
Rabbit
Radish
Rainbow
Raspberry
Rat
Reindeer
Robin
Roots
Rose
Rubber
Salt
Seal

Seeds	Spring beauty	Tea	Wasp
Seed dispersal	Squash	Thistle	Water
Sheep	Squirrels	Toad	Weasel
Silk worm	Starch	Tomato	Weather
Silk	Stars	Trees	Weeds
Slate	Stems	Trillium	Wheat
Snail	Stones	Tulip	Willow
Snake	Strawberry	Turkey	Wind
Snow	Sugar	Turnip	Wood
Snow-bird	Sun	Turtle	Woodpeckers
Snow-drop	Sunflower	Violet	Wool
Soil	Swallow	Walking Stick	Worm
Spider	Sweet Pea		

The list of books which have been helpful to teachers in collecting and arranging the material for tha bove lessons is given here as a hint to the possibilities and is not in any sense a complete catalog.

Nature-Study—Holtz.
Nature-Study and Life—Hodge.
Short Stories of Our Shy Neighbors—Kelly.
Study of Nature—Schmucker.
First Studies of Plant Life—Atkinson.
Nature Study with Common Things—Carter.
Chatty Readings in Elementary Science.
In the Child's World—Poulsson.
Nature Study and the Child—Scott.
Nature Study in Elementary Schools—Wilson.
1st, 2d, 3d, and 4th school Year—California Normal School.
Our Native Trees—Keeler.
Plants and Their Children—Dana.
Nature Study—Overton and Hill.
Friends in Feather and Fur—Johonnot.
Nature Myths—Cooke.
Bird Neighbors—Engell.
Intermediate Plan Book.—George.
Manual of Insects—Comstock.
School Work (Bound Volumes of Magazine).
Lives of the Hunted—Thompson.
Stories of Animal Life—Holder.

Birds and Nature, Vol. 14.
Ways of the Six-footed—Comstock.
Round the Year—Miall.
Squirrels and Other Fur-bearers.
Outdoor Studies—Needham.
Cornell Leaflets.
Natural History Object Lessons—Ricks.
The Bird's Calendar—Parkhurst.
Animal Memoirs—Lockwood.
Insect Folk—Morley.
Nature Study Review (Bound Volumes of Magazine.)
Domesticated Animals—Shaler.
Little Flower Folks—Pratt.
Neighbors with Wings and Fins—Johonnot.
Our Common Birds—Grant.
Elements of Agriculture—Sever.
Nature Biographies—Weed.
The Soil—King.
First Principles of Agriculture—Goff and Mayne.
Star Land—Ball
Giant Sun and His Family—Proctor.
Stories of Rocks and Minerals—Fairbanks.

General Lesson Plan

In the consideration of a lesson or a series of lessons, there must be a general aim which will set forth the object of that group of lessons. Each individual lesson, then, must have a special aim which indicates the object of that day's work. In getting up a lesson, the first thing, of course, after the general aim is settled, is to arrange a series of lessons which will reach the end in view. Now comes the particular lesson.

In the first place we must make use of the more recent acquirements of the pupil and to do this, we recall the points which will be useful in preparing for the lesson of the day. In this we see that the new lesson must first be determined upon in order that we may know what to prepare for. Then we must present the new subject and relate it to the experience of the child and lead him to draw the conclusions. In order

that the work may be useful and fixed in the mind of the pupils and in order that we may be sure that he has really acquired experience, we apply this new knowledge.

We find then that every lesson to be educational, must have the three essentials of getting ready for the lesson, teaching the lesson, and by some means (preferably by application) fixing the knowledge.

Special Lesson Plan

Aim-A. General—Usually the aim of a series of lessons
B. Specific—The object of the individual lesson.

I. Preparation

Matter	Method
Review of material taught which will be useful in the day's lesson.	Manner of review by question and answer, experiment, story, showing material, etc.

II. Presentation

Material for the day's lesson. Pictures, story, apparatus, material, etc.—reading.	Manner of presenting the new material, explanations, question, demonstrations, etc.

III. Association and Comparison

Correlation—subjects and facts related with each other and with known ones.	Manner of correlation, usually by question.

IV. Generalization

Definition.	Question used to bring out definition.

V. Application

Work to fix the knowledge of lesson taught and show the use of lesson.	The manner of treating the examples or method of drill.

In the primary grades the work is usually of such a nature that step IV is omitted. Step III is then combined with II. In many of the lessons the application is better named summary as it is really a summary of the points observed.

Development of Lessons (for Primary Work)

The first consideration in teaching is a thorough preparation on the part of the teacher. That preparation in nature-study means, first, a familiarizing of the teacher with the topic or topics to be considered to the extent of becoming conversant with all available knowledge on the topic from the following sources:

1. Actual observation and experiment.
2. Consultation with the instructor.
3. Books (see card index in the general library).
4. Bound magazines (see Poole's index and Reader's guide).
5. Pamphlets in the science library (see card catalog in science library).
6. Current magazines and periodicals.

Both for the use of observation in preparing the lessons and for clearness and force in presenting them, materials should be collected and preserved. These materials will be used in presenting the lesson or lessons.

The second step is the organization, in an essay, of the facts acquired, especial attention being paid to logical arrangement. Appended to this essay will be a list of the books, periodicals, pamphlets, etc., consulted in the preparation of the article.

The third step is to outline three lessons or series of lessons on this topic suitable for the 1st or 2d, 3d and 4th or 5th grades respectively.

The fourth step is to write out a single lesson (designating the grade for which it is intended) in detail. State explicitly the materials to be used and the use to be made of them.

The following is an outline of the essay and the lessons prepared by Miss Helen J. Bowker of the class of 1909. Owing to lack of space, the essay itself is omitted. The figures in ( ) refer to the numbers in the bibliography. The collection of materials made by Miss Bowker is now in the Nature-Study Museum.

Wool

A. Introduction.
  1. History (1)
    (a) Prehistoric (2)
    (b) Egypt, Rome, Spain (2)
    (c) United States (2) (7)
  2. Commercial importance.
    (a) Sheep raising in foreign countries (2) (5)
    (b) Sheep raising in United States (2)
    (c) Development of wool manufacture.

B. Nature of wool (1) (2)
  1. Derivation of word.
  2. Like and unlike hair.
  3. Characteristics.

C. Grades of wool.
  1. Different breeds of sheep (1)
  2. Care of sheep (2)
  3. Body region (2)
  4. Defects.

D. Washing of sheep (1)

E. Shearing of sheep (1)
  1. By hand.
  2. By machine.

F. Bales.

G. Woolen products.
  1. Woolens (1)
  2. Worsteds (1) (2)
  3. Carpets.
  4. Felts.

H. Woolen manufacture.
  1. Sorting and grading (2)
    (a) Necessity.
    (b) Classification.
    (c) Names used.
  2. Scouring (1) (2)
    (a) Why necessary.
    (b) Materials used.
    (c) Decrease in weight.

3. Oiling (2)
   (a) Necessity.
   (b) Materials used.
4. Coloring.
5. Blending.
   (a) Silk.
   (b) Linen.
   (c) Cotton.
6. Picking or teasing (2)
   (a) Separate fibers.
   (b) Blend colors.
7. Carding.
   (a) Names of cards.
   (b) Description.
8. Spinning.
   (a) By wheel (1)
   (b) By mule (1) (2) (3)
   (c) Description of mule.
   (d) Products.
9. Weaving (1) (2)
   (a) Designing.
   (b) Weaving proper.
10. Milling or fulling.
11. Burling.
12. Mending.
13. Scouring.
14. Finishing.
   (a) Raising gig.
   (b) Teasels.
15. Cropping.
16. Cressing.
17. Pressing.
18. Disposal.

I. Worsted manufacture.
1. Like woolens up to carding (1)
2. Classification.
3. Wool combing.
4. Variations.

J. Carpets (1) (2)
  1. Ingrain.
  2. Brussels.
  3. Tapestry.

K. Felt (1) (2) (6)

L. Waste products.
  1. Shoddy.
  2. Mungo.

M. A trip through a woolen mill.

Bibliography

1. A suit of Clothes.—R. R. Bowker, Harper's Monthly, Vol. 80, p. 685.
2. New International Encyclopedia.
3. Nelson's Encyclopedia.
4. Elements of Zoology.—Holden.
5. The French Woolen Industry—Nation, Vol. 64, p. 410.
6. Jaquard Loom—Century Book of Facts.
7. American Wool Industry—No. Am. Rev.,Vol. 147,p. 219.

This comparatively short bibliography is due to the fact that all of the material used in illustration as well as the ideas contained in the descriptive matter were obtained by the writer at a practical mill in which the operators were courteous enough to give detailed explanations of the work of the different machines and further to explain the grading and preparing of wool for manufacture.

SHEEP—Outline for First and Second Grades

I. Appearance.
  1. Four-footed.
  2. Horns on Head.
  3. Covered with Wool.

II. Size.
  1. Compare with Cat, Dog, Horse, Cow.
  2. Nearest the Dog in Size.
  3. Nearest the Cow in Habits and Structure.

III. Home.
1. Not a wild animal.
2. A tame animal cared for by people.
(a) In pastures in summer.
(b) In barns in winter.
(c) Live in flocks.

IV. Habits.
(a) Live on grain and grass.
(b) Timid.
(c) Sociable.
(d) Make nice pets.

V. Use.
1. Food—Called lamb or mutton.
2. Skins—Sheepskin.
3. Wool—Clothing, carpets, etc.

Materials—Have the children see a sheep, and show them pictures of sheep.

SHEEP—Outline for Third Grade

Review work taken up in 1st or 2d grade.

I. Wool on sheep's body.
1. Sheep's covering.
2. Dirty and greasy.

II. Sheep washing.
1. Washed in running stream.
2. Takes a week or more to dry.

III. Sheep shearing.
A. Hand shearing.
1. Shears used.
2. Sheep thrown and wool cut off.
B. Effect of shearing.
1. Does not hurt sheep.
2. Done in summer, sheep do not catch cold.
3. New wool grows.
4. Old wool would drop off if not cut.

IV. Wool.
1. Put into big bales.
2. Sold to factories.

Materials—Take to pasture and show sheep to children if possible. Have pictures of sheep washing and sheep shearing. Show sheep shears.

SHEEP—Outlined for Fourth and Fifth Grades

Review work of previous years:

I. Sorting.
  1. All wool not alike.
  2. Like wool put together.

II. Cleaning.
  1. Why necessary.
    (a) Wool dirty.
    (b) Wool greasy.
  2. How done.
    (a) Big washing machines.
    (b) Hot soap suds and washing powder.
    (c) Rinsing in clean water.
    (d) Dried.
    (e) Scouring.

III. Carding.
  1. Nature.
    (a) Pulls wool into fluffy mass.
    (b) Comes out in a roll.
  2. Machines.
    (a) Cylinder with sharp steel pegs.
    (b) Number Three.
    (c) Roll smaller every time it comes out.

IV. Spinning.
  1. What it means.
    (a) Pulling thread to make fine.
    (b) Twisting thread to make strong.
  2. How done.
    (a) Machine called "jack" or "mule."
    (b) Little cars stretch thread.
    (c) Bobbins turn and twist thread.

V. Weaving.
  1. Loom (show looms).
  2. Plain weave (paper weaving).
  3. Lengthwise thread called warp.

4. Crosswise thread called woof.

VI. Coloring.

1. Cloth boiled in coloring matter.
2. Cloth rinsed in clear water.

VII. Clothing.

1. Made at home.
2. Made in factories.

VIII. Carpets and Tapestry.

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Materials

Dirty Wool
Scoured Wool
Colored Wool
Roll
Warp
Woof
Shoddy
All Wool Cloth
Hand Loom

The following outlines are suggestive rather than exhaustive. The possibilities of certain classes of topics are hinted at in order that the teacher may have some general working principles. Each heading suggests a problem which may be applied to the appropriate object and propounded to the child. The probabilities are that no one topic would be considered in connection with all these suggestions.

Outline Study of Insects, First Grade

I. Where seen or found
II. General appearance
III. Fy or walk
IV. Food
V. Enemies

Outline Study of Insects, Third Grade

I. Where seen or found
  (a) In water
    1. On top
    2. Under
  (b) On land
    1. In air
    2. On ground
    3. On some plant
II. General appearance
  (a) Head
  (b) Legs
  (c) Wings
  (d) Body
III. Locomotion
  (a) Fly
  (b) Jump
  (c) Walk or run
  (d) Swim
IV. Food
  (a) Larva
  (b) Adult
V. Life history
  (a) Egg, larva, pupa, adult
VI. Means of protection
  (a) Color
  (b) Organs of defense
  (c) Flight or odor
VII. Home

Outline Study of Insects, Fifth Grade

I. Habitat
  (a) Water
  (b) Land
II. Appearance
  (a) Head
    1. Mouth
    2. Antennae
  (b) Thorax
    1. Wings
    2. Legs
  (c) Abdomen
III. Locomotion
  (a) Walk or run
  (b) Jump
  (c) Fly
  (d) Swim
IV. Food
  (a) Of larva
  (b) Of pupa
  (c) Of adult
V. Study of Life history—use of terrarium
VI. Means of protection
  (a) Color
  (b) Organs of defense
  (c) Flight or odor
VII. Home
  (a) Where
  (b) How built
  (c) Length of life
VIII. Economic importance
  (a) To animals
  (b) To man

Outline Study of Birds—First Grade

I. Where seen
II. When seen
III. General color

IV. Actions
V. Nest
VI Bird stories

Outline Study of Birds—Third Grade

I. Characteristics
    Size, shape, color, and markings
II. Food
    Kinds, how obtained, study of bill
    Usefulness of bird
III. Locomotion
    Study of leg, foot, and wings
IV. Nesting habit and nests
    (a) Conditions imposed upon the bird in selecting the site.
    (b) Opportunity offered for nest
    (c) Building the nest
    (d) Condition of young at birth
    (e) Feeding habits
    (f) Solitary or social
    (g) Migration (or permanent residents)
V. Literature
    Story of the red-headed woodpecker
    Birds in song and story
    Bird homes

Outline Study of Birds—Fifth Grade

I. Where seen
  A. In woods
    1. On ground
    2. In bushes
    3. In a tree
  B. In field
    1. On ground
    2. In thicket
    3. On wire
    4. In tree

II. When seen
  (a) In morning
  (b) In evening
  (c) During day
III. Alone or in flocks
IV. How does he escape?
  A. Fly
    1. In straight line
    2. In a wavy line
    3. In short flights
  B. Walk or run
V. Color
  (a) Head
  (b) Breast
  (c) Wings
  (d) Tail
  (e) Rump
VI. Bill
  (a) Shape
  (b) Length
  (c) Color
VII. Legs and feet
  (a) Length of legs
  (b) Color of legs
  (c) Feet
VIII. Food
  (a) What?
  (b) How obtained?
IX. Nest
  A. Nest away
  B. Nest here
    1. Where nest found?
    2. Made of what?
    3. How made?
X. Young
  (a) How many?
  (b) Condition at birth

XI. Migration
  (a) When
  (b) Where
XII. Bird Literature.

Outline Study of Mammals—First Grade

I. Where found or seen
II. General appearance
  (a) Color
  (b) Resemble what other animal
  (c) Unusual parts
III. Movements
IV. Food
V. Home

Outline Study of Mammals—Third Grade

I. Where found or seen
  (a)Wild
  (b) Domesticated
    1. Pets
    2. Useful animals
II. Appearance
  (a) General
  (b) Special
III. Movements
  (a) Locomotion
  (b) Play
IV. Food
  (a) Animal
  (b) Vegetable
  (c) Teeth
V. Home
  (a) Where
  (b) How arranged
VI. Protection
VII. Young

Outline Study of Mammals—Fifth Grade

I. Where found or seen
   (a) In home
      1. House
      2. Out of doors
   (b) In field
      1. In ground
      2. On ground
      3. In trees

II. Appearance
   (a) General
      1. Color
      2. Shape of body
      3. Legs
   (b) Particular
      1. Situation of eyes
      2. Situation and shape of ears
      3. Feet or claws
      4. Tail

III. Movements
   (a) Locomotion
      1. Run, leap, walk, etc.
   (b) Play

IV. Food
   (a) Animal or vegetable
   (b) How secured
   (c) How eaten

V. Home
   (a) Where
   (b) How arranged
   (c) How cared for

VI. Young
   (a) How many
   (b) Appearance
   (c) How cared for

VII. Means of protection
  (a) From enemies
    1. Color
    2. Speed
    3. Organs of defense
  (b) From weather
VIII. Economic value
  (a) To man
  (b) To nature.

Plant Study

I. Where found.
  1. Field
  2. Roadside
  3. Woods
  4. Swamp
  5. Water
II. General appearance
  1. Size
    (a) Tree
    (b) Large plant
    (c) Small plant
  2. Character
    (a) Upright
    (b) Vine
III. Particular appearance
  1. Leaves
    (a) Size
    (b) Shape
  2. Flower
    (a) Size
    (b) Shape
    (c) Color
  3. Stem
    (a) Rough
    (b) Smooth
  4. Fruit
    (a) Juicy

(b) Dry

1. Suggest an outline for the study of trees.
2. Suggest an outline for the study of a flower a little more in detail.
3. With a knowledge of the common trees assumed, outline a series of lessons on elementary forestry.
4. What would be the practical application of this series of lessons?

Meteorology

I. Relation to man
   1. Rainfall
   2. Weather conditions

II. Temperature
   1. Records of temperature impressions
      (a) Based on feelings
      (b) Based on readings of thermometer
   2. Changes of temperature
      (a) Comparison of today with other days
      (b) Time of changes
      (c) Speediness of change
      (d) Kind of change
      (e) Results of change.

III. Storms
   1. Kinds of storms
      (a) Rain
      (b) Snow
      (c) Hail
   2. Conditions favorable for storms
      (a) Temperature
      (b) Wind
      (c) Air

IV. Clouds
   1. Kinds
   2. Motion
   3. Effects

1. Formulate charts which may be used for daily observations of some of the above conditions.
2. Suggest several reasons for the study of the above conditions.
3. Devise experiments which will explain some of the weather phenomena.

Suggested Outline of Work Preparatory to Gardening

I. Origin of Soil
  (a) Early condition of the earth
  (b) Plants and animals
  (c) Results of decay
II. Soil agents
  (a) Air
  (b) Water
    1. Dissolving
    2. Carrying
  (c) Frost
  (d) Wind
  (e) Weight
III. Composition of soil
  (a) Particles of rock
  (b) Decayed plant life
  (c) Remains of animals
IV. Kinds of soil
  (a) Sand
  (b) Gravel
  (c) Muck
  (d) Loam
V. Composition and value of each kind of soil
VI. Plowing, dragging, and harrowing
VII. Drainage
  (a) Kinds of water
  (b) Purpose of drainage
IX. Transplanting
  (a) Purpose
  (b) Time most suitable
  (c) Method of transplanting
XI. Influence of forests, grass, etc.

1. On what previous work might this be based?
2. What practical applications could be made?
3. In what grade could this work be done? Why?

Suggestions for the upper grade lessons are now in preparation.

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